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(54) IMPROVEMENTS IN CONCRETE REINFORCEMENT

(71) We, HOLLANDSCHE BETON GROEP N. V. of Generaal Spoorlaan 489, Rijswijk (Z. H.), Holland, a Dutch Company, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to reinforced concrete.

Since it was realised that glass fibre-reinforced plastics was a true example of a two-phase material product, research has been going on with the purpose of using glass fibres as a reinforcement in concrete mixes.

Glass fibres, however, are aggressively attacked during hydration of the concrete by alkali material and it has therefore been considered necessary to use glass fibre, either of a type which can withstand the alkaline aggression, or a "normal" glass fibre enveloped in a protective coating that could withstand the alkaline attack.

According to the present invention there is provided a method of making reinforced concrete which includes the steps of first treating glass fibres by immersion in an alkali solution and then incorporating the treated fibres in the concrete, the glass fibres being immersed in the said solution for such a period of time that the aggressive effect of the alkali solution is greater than the alkaline aggressiveness of the concrete, in which the fibres are to be incorporated, would be upon an untreated fibre.

The term "immersed", where used in this specification, includes passing the fibres continuously through a solution, which may, for example, be contained in a bath or be sprayed on to the fibres, in addition to the static immersion of the fibres.

The alkali solution may, for example, be a solution of sodium hydroxide or any other hydroxide or alkali.

This pre-treatment or "curing" of the glass fibres not only improves the bond between the reinforcing fibres and the concrete but also enables the hydration time to be shortened which may be desirable in certain cases. This is particularly the case if the pre-treating solution consists of a sodium silicate colloidal solution. The dual effect of alkaline aggression and coating capacity of such a solution can be further enhanced if shortly after the pre-treatment described, the glass fibres are further treated by an application of a mild or highly diluted acid, for example a 2.5% solution of acetic acid, so as to form a silica-gel top layer.

A further advantage of the invention is that the pre-treatment can be effected at any desired time, with conventional applicators, so that glass fibres can be treated directly after the glass leaves the "spinning head" or even some hours later before the fibres are actually mixed with the mixed components of the concrete in the mixer.

In making reinforced concrete in accordance with the invention it is possible, not only to incorporate the treated fibers in the cement mixture during mixing, but also to position the fibres in a mould and then to pour the cement mixture around them. The method of the invention is particularly suitable for the making of moulded shapes using a mixture in a relatively liquid form from which the water can easily be removed by pressing or other extraction means.

"Normal" glass fibres, which term where used herein means glass fibres actually available on the open market, were treated (a) by immersion in sodium hydroxide solution, (0.1 Normal) at 30°C for ten minutes, (b) by immersion in sodium hydroxide solution (1 normal) for one minute at 35°C and (c) by immersion in a sodium silicate colloidal solution, concentration 38° Baume, diluted with water in even parts at 50°C. In each case the fibres experienced a reduction in tensile strength of between 28% and 40%. However, even after exposure to additional attack by a strong alkali over long periods of time, no further reduction was experienced with any of the treated glass fibres.

A study of the treated fibres under the microscope showed that the alkaline attack provided a surface which enabled an improved bond to be achieved between the fibres and a cement matrix.

It is possible to compensate for the effect

of the alkali attack upon the tensile strength of the fibres by starting with fibres having a larger diameter than is apparently required so that after the alkali treatment with its accompanying reduction in tensile strength, fibres are provided which have the required tensile strength, improved bonding properties and good alkali resistance.

WHAT WE CLAIM IS:—

1. A method of making reinforced concrete which includes the steps of first treating glass fibres by immersion in an alkali solution and then incorporating the treated fibres in the concrete, the glass fibres being immersed in the said solution for such a period of time that the aggressive effect of the alkali solution is greater than the alkaline aggressiveness of the concrete, in which the fibres are to be incorporated, would be upon an untreated fibre.

2. A method as claimed in claim 1 in which the alkali solution is a sodium hydroxide solution.

3. A method as claimed in claim 1 in which the alkali solution is a sodium silicate colloidal solution.

4. A method as claimed in claim 3 in which the treated fibres are further treated with an acid in order to form a silica-gel layer on the fibres.

5. A method as claimed in any one of the preceding claims in which the fibres are treated as they leave the "spinning head" of a machine.

6. Reinforced concrete made by a method as described in any one of the preceding claims.

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